25.1 Adrenergics and Anticholinergics

LEARNING OUTCOMES

By the end of this section, you should be able to:

25.1.1 Discuss the use of adrenergic and anticholinergic drugs used to treat lower respiratory disorders.
25.1.2 Explain the indications, actions, adverse reactions, and interactions of adrenergic and anticholinergic drugs used to treat lower respiratory disorders.
25.1.3 Describe nursing implications of adrenergic and anticholinergic drugs used to treat lower respiratory disorders.
25.1.4 Explain the client education related to adrenergic and anticholinergic drugs used to treat lower respiratory disorders.

Adrenergics

Adrenergic drugs, also known as **sympathomimetic** drugs, are a class of medications that that bind to adrenergic receptors throughout the body. These receptors are stimulated by the neurotransmitters **norepinephrine** and **epinephrine**, also known as adrenaline. Adrenergic drugs mimic the effects of these neurotransmitters or enhance their activity, resulting in a wide range of physiological responses. These medications can act on different types of adrenergic receptors, including alpha-adrenergic receptors and beta-adrenergic receptors, producing diverse effects on various organ systems. Adrenergic drugs are used to manage several conditions, such as asthma, and they play a crucial role in bronchodilation (Farzam et al., 2022).

Beta Adrenergics

Beta-adrenergic drugs target beta-adrenergic receptors in the sympathetic nervous system. These receptors are found in various tissues, including the heart, lungs, and smooth muscles, and lead to smooth muscle relaxation.

One type of beta-adrenergic receptor, beta 2, is predominantly found in the smooth muscles of the lungs, bronchioles, and blood vessels. Stimulating these receptors leads to bronchodilation and vasodilation. Medications like albuterol, levalbuterol, and salmeterol are frequently used in the treatment of respiratory conditions, such as asthma and COPD, that cause bronchoconstriction.

Albuterol is a short-acting beta-2 adrenergic agonist and is primarily used to treat and manage respiratory conditions such as asthma, COPD, and exercise-induced bronchospasm. Albuterol works by engaging or stimulating the beta-2 adrenergic receptors, relaxing the smooth muscles in the airways and leading to bronchodilation and improved airflow. Albuterol is often used as a rescue medication for acute asthma attacks and as maintenance therapy for COPD (Hsu & Bajaj, 2023).

Levalbuterol and salmeterol are also beta-adrenergic agonists and are used to treat asthma and COPD. Levalbuterol is a short-acting beta-2 agonist, and salmeterol is a long-acting beta-2 agonist. Salmeterol is used as a maintenance therapy to prevent asthma and should not be used for immediate relief of an asthma attack, whereas levalbuterol is used similarly to albuterol.

Table 25.1 lists common beta adrenergics used for lower respiratory system disorders and typical routes and dosing for adult and pediatric clients.

Drug	Routes and Dosage Ranges
Albuterol (Accuneb, Proventil, Ventolin)	*In adults for acute episodes of bronchospasm or prevention of asthmatic symptoms:* 2 inhalations (2.5 mg per inhalation) every 4–6 hours. Some clients may only need 1 inhalation every 4 hours. *In adults for exercise-induced bronchospasm prevention:* 2 inhalations (2.5 mg per inhalation) 15 minutes prior to exercise. *In children age 2–12:* 1.25 mg or 0.63 mg 3–4 times daily via nebulization.
Levalbuterol (Xopenex)	*Adults:* 0.63 mg every 6–8 hours by nebulization. *Children 6–11:* 0.31 mg 3 times per day by nebulization, not to exceed 0.63 mg 3 times a day.
Salmeterol (Serevent)	*For bronchodilation and prevention of asthma symptoms:* 1 inhalation (50 mcg) twice daily, 12 hours apart, in combination with inhaled corticosteroids. *For exercise-induced bronchospasm:* 1 inhalation (50 mcg) 30 minutes prior to exercise. *For COPD:* 1 inhalation (50 mcg) twice daily 12 hours apart.

Table 25.1 Drug Emphasis Table: Beta Adrenergics (source: https://dailymed.nlm.nih.gov/dailymed/)

Adverse Effects and Contraindications

Common adverse effects include tremors, nervousness, headache, and tachycardia. Cold symptoms, migraine, chest pain, bronchitis, and nausea have also been reported. Clients with severe cardiac disease should use albuterol only at the direction of their health care provider due to systemic effects on heart rate and blood pressure (DailyMed, *Albuterol sulfate*, 2023).

Table 25.2 is a drug prototype table for beta adrenergics featuring albuterol. It lists drug class, mechanism of action, adult and pediatric dosage, indications, therapeutic effects, drug and food interactions, adverse effects, and contraindications.

Drug Class Beta adrenergic **Mechanism of Action** Relaxes bronchial, uterine, and vascular smooth muscle by stimulating beta-2 receptors	**Drug Dosage** *In adults for acute episodes of bronchospasm or prevention of asthmatic symptoms:* 2 inhalations (2.5 mg per inhalation) every 4–6 hours. Some clients may only need 1 inhalation every 4 hours. *In adults for exercise-induced bronchospasm prevention:* 2 inhalations (2.5 mg per inhalation) 15 minutes prior to exercise. *In children ages 2–12:* 1.25 mg or 0.63 mg 3–4 times daily via nebulization.
Indications Prevention and relief of bronchospasm Prevention of exercise-induced bronchospasm **Therapeutic Effects** Bronchodilation Relief of bronchospasm	**Drug Interactions** Antiarrhythmics Beta blockers CNS stimulants **Food Interactions** No significant interactions
Adverse Effects Tremor Nervousness Tachycardia Headache	**Contraindications** Hypersensitivity Caution: Cardiac disorder Hyperthyroidism Diabetes Severe cardiac disease

Table 25.2 Drug Prototype Table: Albuterol (source: https://dailymed.nlm.nih.gov/dailymed/)

Alpha- and Beta-Adrenergic Agonists

Alpha- and beta-adrenergic agonists stimulate both alpha- and beta-adrenergic receptors. Alpha-adrenergic receptors are found primarily in smooth muscles, regulating vasoconstriction and blood pressure. Beta-adrenergic receptors are present in the heart, lungs, and other tissues and control heart rate, bronchodilation, and metabolic processes.

Ephedrine, a sympathomimetic drug, acts as a nonselective alpha- and beta-adrenergic agonist, meaning it stimulates both types of receptors. The ability of ephedrine to activate both receptor types makes it a widely used drug for conditions such as asthma and nasal congestion as well as low blood pressure. However, its usage requires caution due to potential side effects and interactions with other medications (Drugbank Online, 2023).

Epinephrine is used often as an emergency treatment for allergic reactions and respiratory distress including anaphylaxis. It works by relaxing and opening air passages to allow for easier breathing. It can be given as an oral inhalation, intravenously, subcutaneously, and as an intramuscular injection (Dalal & Grujic, 2023). Epinephrine can cause anxiety, tremors, palpitations, nausea, and headache.

Table 25.3 lists common alpha and beta adrenergics used for lower respiratory system disorders and typical routes and dosing for adult clients.

Drug	Routes and Dosage Ranges
Ephedrine (Emerphed, Corphedra)	1–2 tablets (12.5 mg each) every 4 hours as needed. Maximum dose: 12 tablets in 24 hours.
Epinephrine (Adrenalin, Auvi-Q, Epipen, Primatene Mist)	*Inhalation:* 1 inhalation as needed. Wait 1 minute, then take second inhalation. Wait at least 4 hours between doses. Maximum dose: 8 inhalations in 24 hours. *Intramuscular or subcutaneous:* 0.3–0.5 mg (0.3–0.5 mL) of undiluted epinephrine administered in the anterolateral aspect of the thigh, repeated every 5–10 minutes as necessary. Maximum dose: 0.5 mg (0.5 mL) per injection. Intended for severe exacerbation and/or when inhalation is not available.

Table 25.3 Drug Emphasis Table: Alpha and Beta Adrenergics (source: https://dailymed.nlm.nih.gov/dailymed/)

Adverse Effects and Contraindications

Ephedrine can cause an increase in heart rate and blood pressure, insomnia, and tremors. Clients who have hypersensitivity or who have been taking a monoamine oxidase inhibitor (MAOI) should not use ephedrine (DailyMed, *Ephedrine hydrochloride*, 2022).

Epinephrine can cause anxiety, restlessness, and headache. Clients may also report chest pain, high blood pressure, dizziness, and difficulty sleeping.

Table 25.4 is a drug prototype table for alpha and beta adrenergics featuring ephedrine. It lists drug class, mechanism of action, adult dosage, indications, therapeutic effects, drug and food interactions, adverse effects, and contraindications.

Drug Class	Drug Dosage
Adrenergic **Mechanism of Action** Relaxes bronchial smooth muscle by stimulating beta-2 receptors	1–2 tablets (12.5 mg per tablet) every 4 hours as needed. Maximum dose: 12 tablets in 24 hours.

Stimulates alpha- and beta-adrenergic receptors in the sympathetic nervous system	
Indications Mild/intermittent asthma **Therapeutic Effects** Bronchodilation Relief of bronchospasm	**Drug Interactions** Alpha blockers Beta blockers Cardiac glycosides MAOIs **Food Interactions** No significant interactions
Adverse Effects Nervousness Palpitations Tachycardia Headache	**Contraindications** Angle-closure glaucoma Heart failure Intermittent asthma Cardiovascular disease Hypertension Stroke Caution: Bronchial asthma or emphysema with degenerative heart disease

Table 25.4 Drug Prototype Table: Ephedrine (source: https://dailymed.nlm.nih.gov/dailymed/)

Anticholinergics

Anticholinergic drugs block the action of **acetylcholine** at muscarinic receptors, which are found in numerous organs and tissues throughout the body. They produce a range of effects such as relaxation of smooth muscles, reduction in secretions, and inhibition of parasympathetic responses. These medications are useful in the treatment of various conditions, including respiratory disorders, overactive bladder, gastrointestinal disorders, and certain neurological conditions.

SAFETY ALERT

Side Effects of Anticholinergics

Anticholinergics should be used with caution due to potential side effects, especially in older adults, who may be more susceptible to adverse reactions like cognitive impairment and increased risk of falls.

Two commonly used respiratory anticholinergics are ipratropium bromide and tiotropium. Ipratropium bromide, often administered via inhalation, acts as a bronchodilator by blocking the action of acetylcholine at the muscarinic receptors in the airways. This helps to relax the smooth muscles and widen the air passages, providing relief from symptoms such as wheezing and shortness of breath in conditions like asthma and COPD.

Tiotropium, also an inhalation medication, is a long-acting anticholinergic that provides sustained bronchodilation by binding specifically to the muscarinic receptors in the airways. It is primarily used for the long-term maintenance treatment of COPD to reduce symptoms and improve lung function.

Table 25.5 lists common anticholinergics used for lower respiratory system disorders and typical routes and dosing for adult clients.

Drug	Routes and Dosage Ranges
Ipratropium bromide (Atrovent)	*Metered-dose inhaler (17 mcg):* 4–8 inhalations with spacer every 20 minutes for 3 doses, then hourly as needed for up to 3 hours. *Nebulization (500 mcg)*: 3–4 times daily, with doses 6–8 hours apart.
Tiotropium (Spiriva)	*Hand inhaler:* 2 inhalations of the powder contents of 1 Spiriva capsule, once daily. *Spiriva Respimat inhaler:* For COPD: 2 inhalations (2.5 mcg each) per device actuation once daily. *For asthma:* 2 inhalations (1.25 mcg each) once daily.

Table 25.5 Drug Emphasis Table: Anticholinergics (source: https://dailymed.nlm.nih.gov/dailymed/)

Adverse Effects and Contraindications

Side effects of both drugs can include dry mouth, headache, nervousness or dizziness, blurred vision, constipation, and cough. Clients with hypersensitivity, narrow-angle glaucoma, and urinary retention should avoid these drugs; they can cause urinary retention and exacerbate symptoms.

Table 25.6 is a drug prototype table for anticholinergics featuring ipratropium bromide. It lists drug class, mechanism of action, adult dosage, indications, therapeutic effects, drug and food interactions, adverse effects, and contraindications.

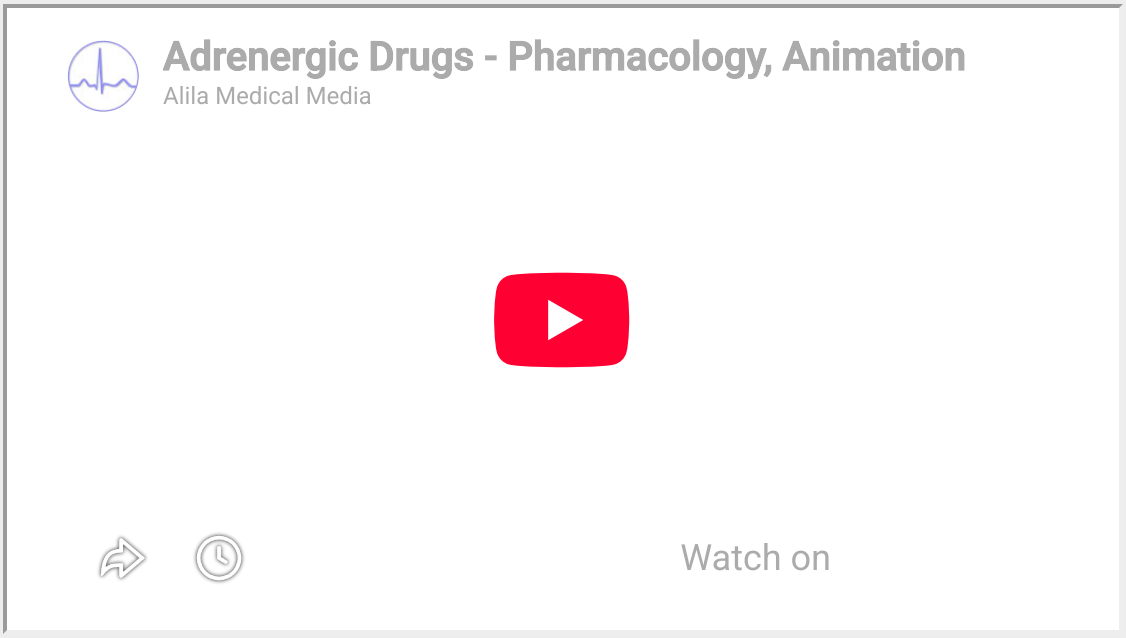
Drug Class	Drug Dosage
Anticholinergic **Mechanism of Action** Inhibits vagally mediated reflexes by	*Metered-dose inhaler (17 mcg):* 4–8 inhalations with spacer every 20 minutes for 3 doses, then hourly as needed for up to 3 hours.

antagonizing acetylcholine at muscarinic receptors on bronchial smooth muscle	*Nebulization (500 mcg)*: 3–4 times daily, with doses 6–8 hours apart.
Indications Bronchospasm Relief of acute asthmatic symptoms (when combined with albuterol) **Therapeutic Effects** Bronchodilation Relief of bronchospasm	**Drug Interactions** Other anticholinergics **Food Interactions** No significant interactions
Adverse Effects Dizziness Urinary retention Palpitations Tachycardia Blurred vision Constipation Dry mouth	**Contraindications** Hypersensitivity Caution: Angle-closure glaucoma Bladder neck obstruction Prostatic hyperplasia

Table 25.6 Drug Prototype Table: Ipratropium Bromide (source: https://dailymed.nlm.nih.gov/dailymed/)

LINK TO LEARNING

Adrenergics



In this link to learning, Alila Medical Media presents information on the pharmacology and action of adrenergics. This educational video with animation discusses the different types of adrenergic receptors and the different types of drugs that act on them.

Nursing Implications

The nurse should do the following for clients who are taking adrenergic or anticholinergic drugs:

- Prior to administering, assess the client's medical history, current drug list, and allergies.
- Assess the client's baseline respiratory function.
- Ensure the drug is prepared appropriately using aseptic technique, and verify dosage prior to administration.
- Monitor the client's response to the drug, including any changes in breathing effort, rate, and oxygen saturation.
- Provide client teaching regarding the drug and when to call the health care provider. See below for client teaching guidelines.

CLIENT TEACHING GUIDELINES

The client taking an adrenergic or anticholinergic drug should:

- Take the drug as prescribed without skipping doses or stopping therapy.
- Prime the inhaler prior to use by shaking it and spraying into the air for a total of 4 sprays. Clean it after use by rinsing it with water and allowing it to dry.
- Wait at least 15 seconds between inhalations if more than one is required.
- Inform the health care provider of worsening symptoms including shortness of breath, cough, chest tightness, and wheezing.
- Create an asthma action plan. The Asthma and Allergy Foundation of America provides an example.

The client taking an adrenergic or anticholinergic drug *should not:*

- Use more medication than was prescribed by the health care provider.
- Wash or place a powder inhaler in water.

UNFOLDING CASE STUDY

Part A

Read the following clinical scenario to answer the questions that follow. This case study will evolve throughout the chapter.

Harold Watson is a 65-year-old client who presents to his primary care physician with complaints of worsening shortness of breath, chronic cough, and increased sputum production over the past few months. He reports that these symptoms have significantly impacted his daily activities, and he has also noticed a decrease in his ability to perform simple tasks around the house. Harold reports that he quit smoking 10 years ago but was a heavy smoker for 30 years. He reports smoking roughly one pack of cigarettes per day when he was smoking.

History
Hypertension

Current Medications
Metoprolol 100 mg daily

Vital Signs		Physical Examination
Temperature:	98.7°F	• *Head, eyes, ears, nose, throat (HEENT):* Denies any changes in vision. No difficulty hearing. • *Cardiovascular:* S1, S2 noted. Denies chest pain. Capillary refill less than 3 seconds. • *Respiratory:* Decreased breath sounds in the lower lung fields, prolonged expiration and mild wheezing. • *GI:* Abdomen soft, nontender, nondistended; bowel sounds present in all four quadrants. • *GU:* Denies difficulty with urination. • *Neurological:* Alert and oriented ×4. Denies any dizziness, numbness, or tingling in extremities. • *Integumentary:* No wounds noted.
Blood pressure:	145/90 mm Hg	
Heart rate:	92 beats/min	
Respiratory rate:	20 breaths/min	
Oxygen saturation:	91% on room air	
Height:	5'6"	
Weight:	175 lb	

Table 25.7

1. Based on the assessment of Harold, what diagnosis should the nurse anticipate from the health care provider?
   a. Elevated blood pressure
   b. COPD
   c. Allergic reaction
   d. Bronchospasm

2. Based on Harold's past medical history of chronic obstructive pulmonary disease (COPD) and the physical examination, which of the following medications would be the highest priority to administer to him?
   a. Salmeterol
   b. Ipratropium bromide
   c. Tiotropium
   d. Ephedrine